



Draft 2017 CELT ISO-NE Annual Energy and Summer Peak Forecast

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SYSTEM PLANNING



Outline

- Introduction and Highlights
- Review of Seasonal Peak Demand and Annual Energy
- Draft 2017 Energy-Efficiency (EE) Forecast
- Draft 2017 Photovoltaic (PV) Forecast
- Draft 2017 Annual Energy and Summer Peak Forecast
- Next Steps

Introduction

Explanation of Gross and Net Load Forecasts in CELT

- ISO first develops “gross” load forecasts that reflect a forecast of load without reductions from passive demand resources (PDR) and behind-the-meter PV (BTM PV)
 - PDR and BTM PV are reconstituted into historical hourly loads used to estimate gross load forecast models
 - This ensures the proper accounting of PDR and BTM PV, which are both forecast separately
- “Net” load forecasts are developed by subtracting the PDR (from FCM and the EE forecast) and BTM PV from the gross forecasts
 - Net loads are intended to be representative of energy and loads observed in New England
- In general, changes reflected in the draft 2017 load forecast relative to the 2016 CELT can be divided into the following three components:
 1. Gross load forecast updates:
 - a) Updated macroeconomic forecast from Moody’s
 - b) Updated historical data used to estimate gross load forecasts
 2. Changes to the EE forecast
 3. Changes to the PV forecast

Draft 2017 CELT Forecast Highlights

- Compared to 2016 CELT forecasts, changes reflected in the draft 2017 CELT include:
 - Macroeconomic outlook forecasts slightly lower economic growth in New England than last year
 - Gross forecasts
 - Annual energy is approximately 1.0% lower in 2025
 - Summer 50/50 is approximately 0.9% lower in 2025
 - Summer 90/10 is approximately 0.7% lower in 2025
 - BTM PV forecast is approximately 15% higher in 2025
 - EE forecast is approximately 11% higher in 2025
 - Net forecasts
 - Annual energy forecast is approximately 3.9% lower in 2025
 - Summer 50/50 forecast is approximately 3% lower in 2025
 - Summer 90/10 forecast is approximately 2.7% lower in 2025

REVIEW OF SEASONAL PEAK DEMAND AND ANNUAL ENERGY

- *Summer 2016*
- *Winter 2016/2017*
- *2016 Annual Energy*

Annual Energy (GWh)

2016 vs. 2015

- After adjusting for weather and weekday/weekend effects, energy consumption is down 1.5% compared to weather normal 2015 energy
- After reconstituting for Forward Capacity Market (FCM) Passive Demand Resources (PDR), energy consumption is down 0.3% compared to 2015
- The 2016 weather normal energy reconstituted for PDR is 138,333 GWh, 0.5% (635 GWh) lower than the 2016 CELT forecast of 138,968 GWh

	2015	2016	Change	% Change
Weather Normal Energy, GWh	125,779	123,953	-1,826	-1.5
Passive Demand Resources, GWh	12,960	14,380	1,420	11.0
Weather Normal Energy + PDR, GWh	138,739	138,333	-406	-0.3

2016 Summer Peak Demand Review (MW)

- ISO's long-term summer load forecast uses a 3-day, eight-city weighted temperature-humidity index (WTHI)
- The 50/50 weather normalized gross peak load for the summer of 2016 is 28,815 MW, 0.5% (151 MW) lower than the 2016 CELT forecast of 28,966 MW for the summer of 2016
- The 90/10 weather normalized gross peak load for the summer of 2016 is 31,200 MW, 0.3% (103 MW) lower than the 2016 CELT forecast of 31,303 MW for the summer of 2016
- The ISO New England Control Area actual summer peak load of 25,596 MW, occurred on August 12 at HE 1500. At the hour of the peak the temperature was 93° F, dew point was 72° F and the WTHI was 81.7° F
 - After reconstitution for OP4 active demand resources (0 MW), FCM passive demand resources (2,191 MW), and Behind-the-Meter PV (717 MW), the gross peak was 28,504 MW

2016 Summer Peak Demand Days

- The table below lists the five highest peak net demand days and WTHIs this past summer with respect those of the 2016 50/50 and 90/10 summer peak demand forecasts published in 2016 CELT

Peak Day	Day of Week	Peak Net Load*	Peak Hour	WTHI	PV
90/10 Forecast	-	29042	-	82.0	423
50/50 Forecast	-	26704	-	79.9	423
8/12/2016	Fri	25596	15	81.7	717
8/11/2016	Thu	25262**	17	78.0	449
7/22/2016	Fri	24416	17	78.1	506
8/14/2016	Sun	24070	18	79.9	248
7/26/2016	Tue	23970	17	77.2	521

* Forecast loads are net of forecasted impacts of Passive and Active Demand Resources and behind-the-meter PV; actual peak loads are those measured in real-time

** Peak is reconstituted for Real Time Demand Resources dispatched during OP4, Action 2 (162 MW)

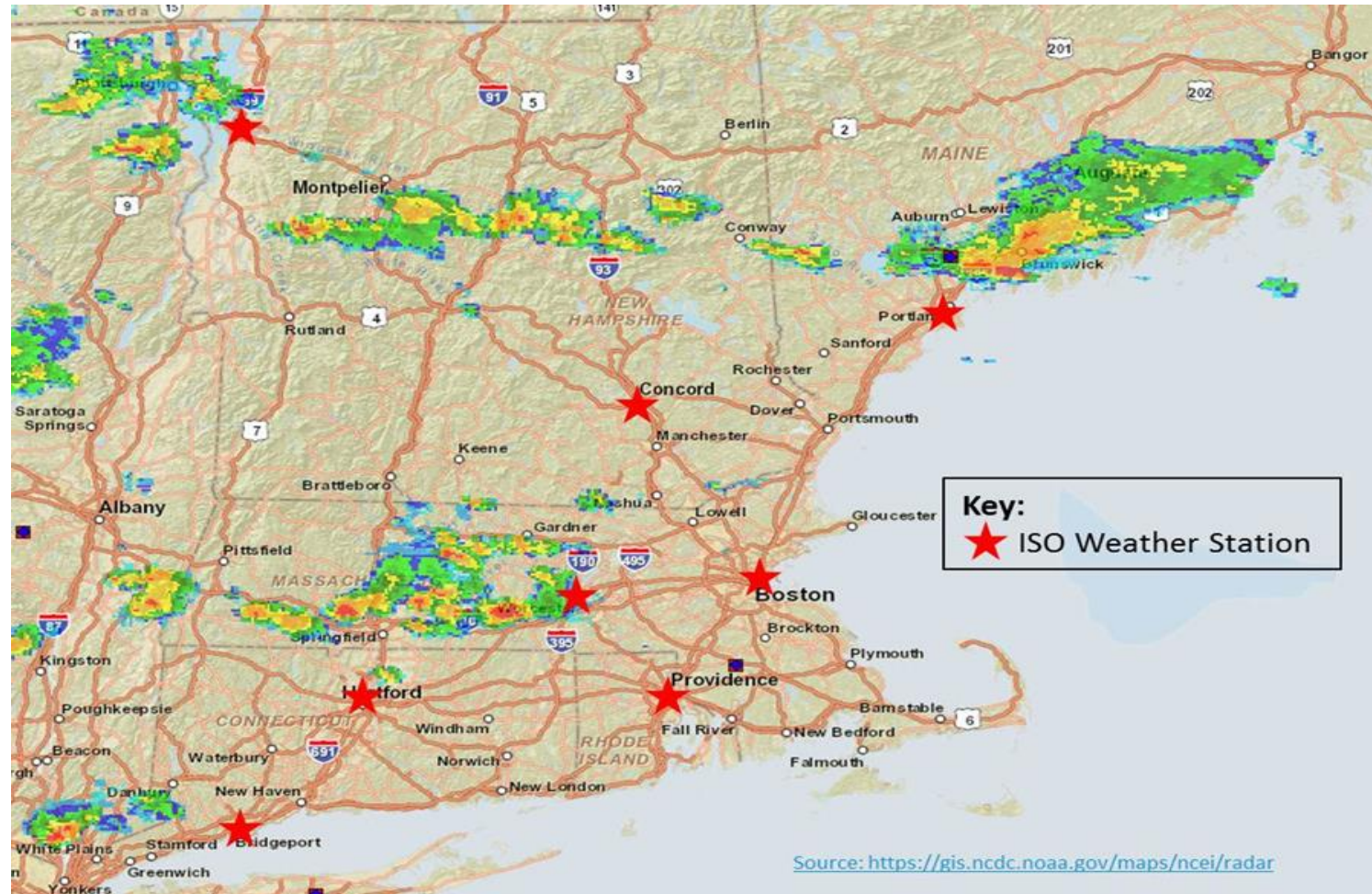
2016 Summer Seasonal Peak – Friday, August 12, 2016

Observed Load vs. 2016 CELT Forecast

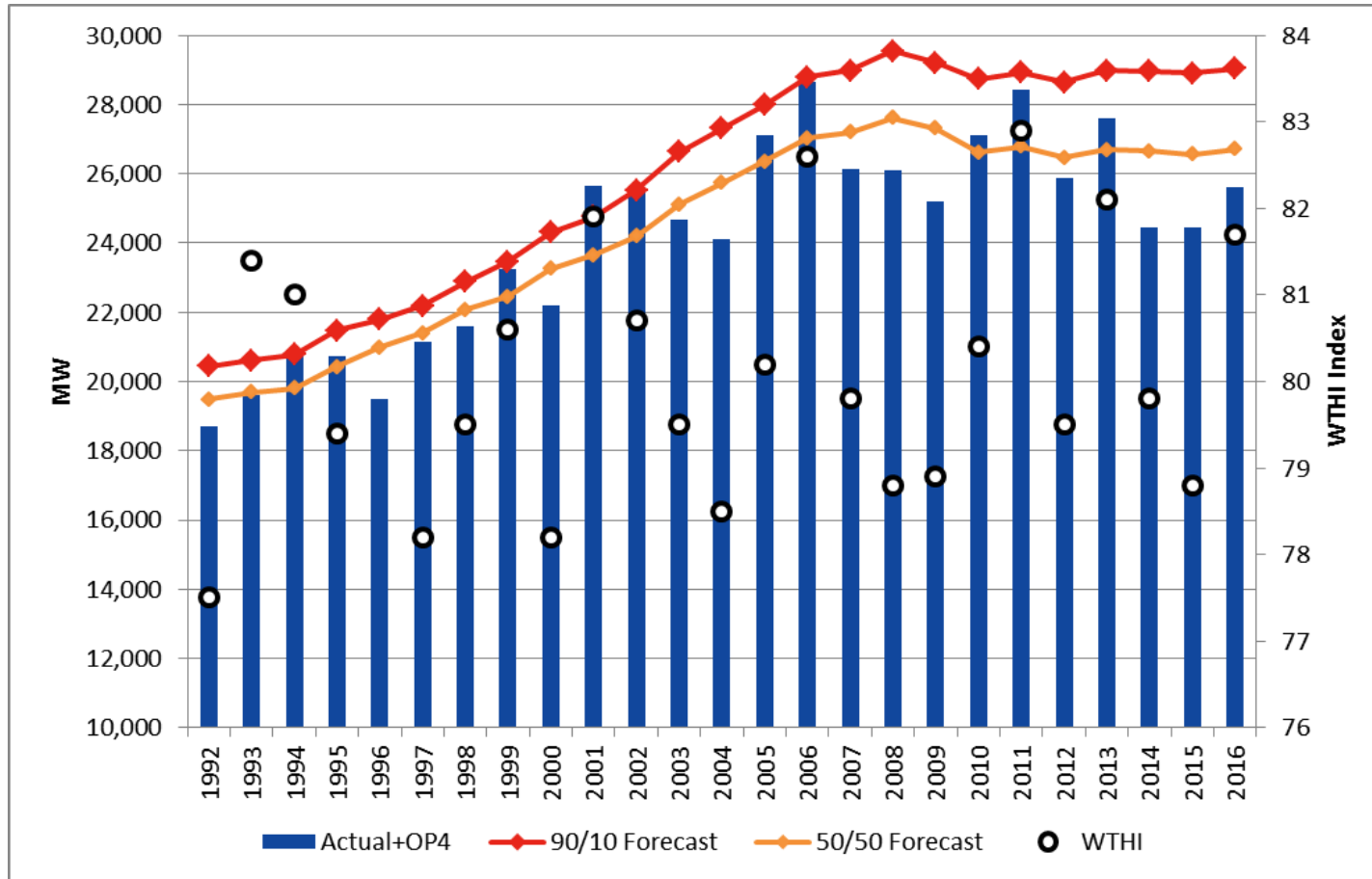
- On August 12, the observed weather at ISO's eight weather stations was more severe than the weather assumed for the 50/50 long-term load forecast, but less severe than the 90/10 forecast
- Despite the relatively severe weather, the observed system peak load on August 12 was about 1,100 MW lower than the 2016 CELT 50/50 summer load forecast, predominantly due to three factors
 1. Peak occurred on a Friday – Based on previous analysis, peak loads on Fridays can be up to 1,000 MW lower than other non-holiday weekdays, given similar weather
 2. Areas of localized thunderstorms and rain passed through some load centers immediately preceding and during the peak, resulting in reduced loads
 - Some storms were located in areas outside of ISO's eight weather stations, and were therefore not well reflected in ISO's measured weather during the peak hour
 - Radar imagery during the peak is shown on the next slide
 3. Peak occurred at hour ending 15, resulting in more BTM PV load reduction (717 MW) than forecast (423 MW)

2016 Summer Seasonal Peak – August 12, 2016

Radar at 3PM (Peak Hour)



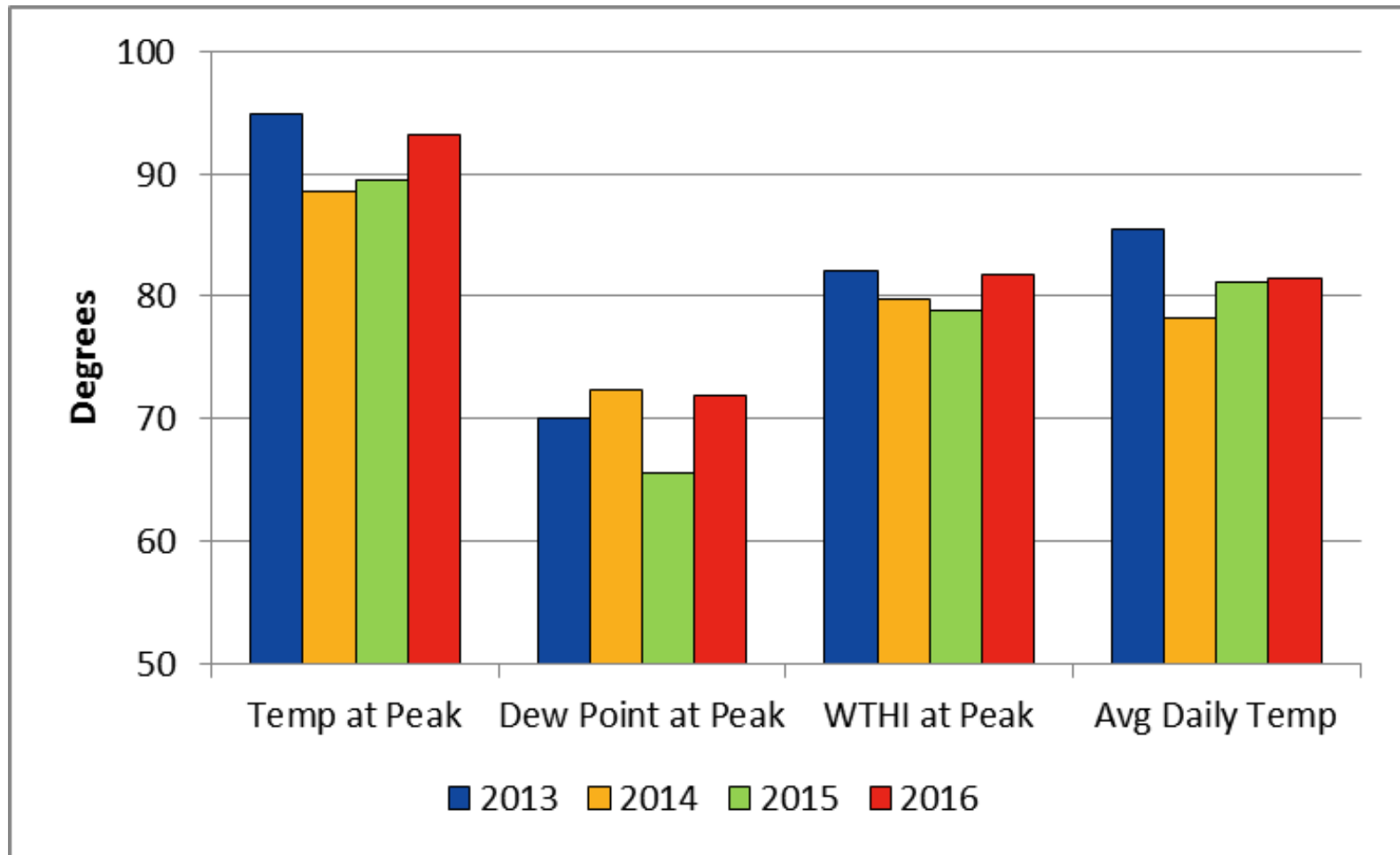
ISO-NE Historical Summer Peaks and Weather 1992-2016



Note: Peaks are reconstituted for actions taken during a capacity deficiency

ISO-NE Summer Weather Statistics, 2013-2016

Weather During Seasonal Peaks



2016/2017 Winter Peak Demand

- The 50/50 weather normalized gross peak load for the winter of 2016/17 is 22,900 MW, 0.4% (92 MW) lower than the 2016 CELT forecast of 22,992 MW for the winter of 2016/17
- The ISO New England Control Area actual winter peak load of 19,581 MW, occurred on December 15, 2016 at HE 1800. At the hour of the peak the temperature was 18° F
 - After reconstitution for OP4 active demand resources (0 MW), FCM passive demand resources (2,604 MW), and Behind-the-Meter PV (0 MW), the gross peak was 22,185 MW
- January's actual winter peak of 19,570 MW, occurred on the January 9, 2017 at HE 1800. At the hour of the January peak the temperature was 17° F
- The 2016/17 actual winter peak is similar to the 2015/16 actual winter peak of 19,561 MW, which occurred February 15, 2016 at HE 1800 at a temperature of 18° F

DRAFT 2017 ENERGY-EFFICIENCY FORECAST

Summary of Draft 2017 EE Forecast

- Draft Energy-Efficiency forecast (EEF) results in an increase from the 2016 forecast due to a revised production cost escalation methodology
 - Moved from a 5% static escalator to a 1.25% graduated escalator
- Details of the draft 2017 forecast are available at
 - <http://www.iso-ne.com/committees/planning/energy-efficiency-forecast>
- Program performance changes from the 2016 forecast include:
 - Production Costs increased in ME, VT, and CT resulting in a decrease in energy reductions from equivalent budget
 - Production Costs remained constant in NH and RI and fell slightly in MA
 - Peak-to-Energy Ratios decreased in RI and VT, but increased in the remainder of the region
 - Budget Spend Rates increased modestly across the region, with significant improvement in ME

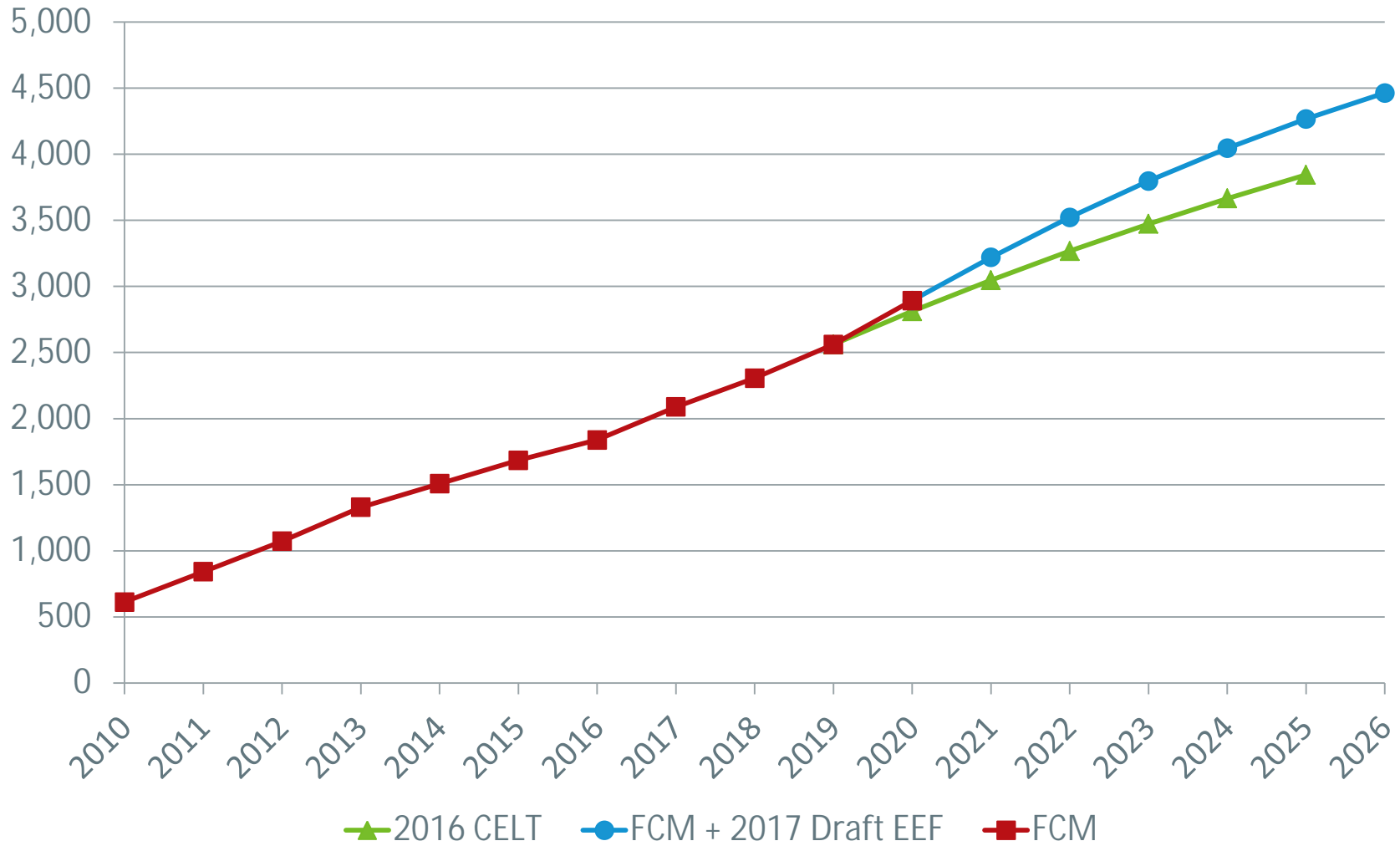
EE Forecast Model General Assumptions

- Annual EE budgets provided by the Commissions or representatives on their behalf were used in the model and held constant in years after the latest approved budget
- Peak-to-Energy Ratios were derived from a three-year average of recent performance and held constant through the forecast period
- Production cost baselines were derived from a three-year average of recent performance
- Production costs escalated at a 1.25% graduated rate that begins in the second year of the forecast
- Inflation rate was set at 2.5% per year
- The 2016 CELT energy forecast is used in conjunction with System Benefit Charges (SBC) to forecast SBC dollars

Energy and Summer Peak EE Forecast Data

GWh Savings								
	ISONE	ME	NH	VT	CT	RI	MA	
2021	2,384	152	65	117	419	185	1,447	
2022	2,201	140	61	111	390	169	1,330	
2023	2,008	127	57	104	358	153	1,209	
2024	1,811	114	52	96	325	137	1,087	
2025	1,617	101	47	90	292	122	966	
2026	1,427	89	42	81	258	107	849	
Total 2021-2026	11,448	723	323	600	2,042	872	6,888	
Average	1,908	120	54	100	340	145	1,148	
MW Savings								
	ISONE	ME	NH	VT	CT	RI	MA	
2021	327	18	10	14	57	26	202	
2022	302	16	9	13	53	24	186	
2023	275	15	8	12	49	21	169	
2024	248	13	8	11	45	19	152	
2025	222	12	7	11	40	17	135	
2026	196	10	6	10	35	15	119	
Total 2021-2026	1,570	84	48	71	279	122	963	
Average	262	14	8	12	47	20	161	

Energy Efficiency on Summer Peak (MW)



DRAFT 2017 PV FORECAST

Summary: Draft CELT 2017 PV Forecast

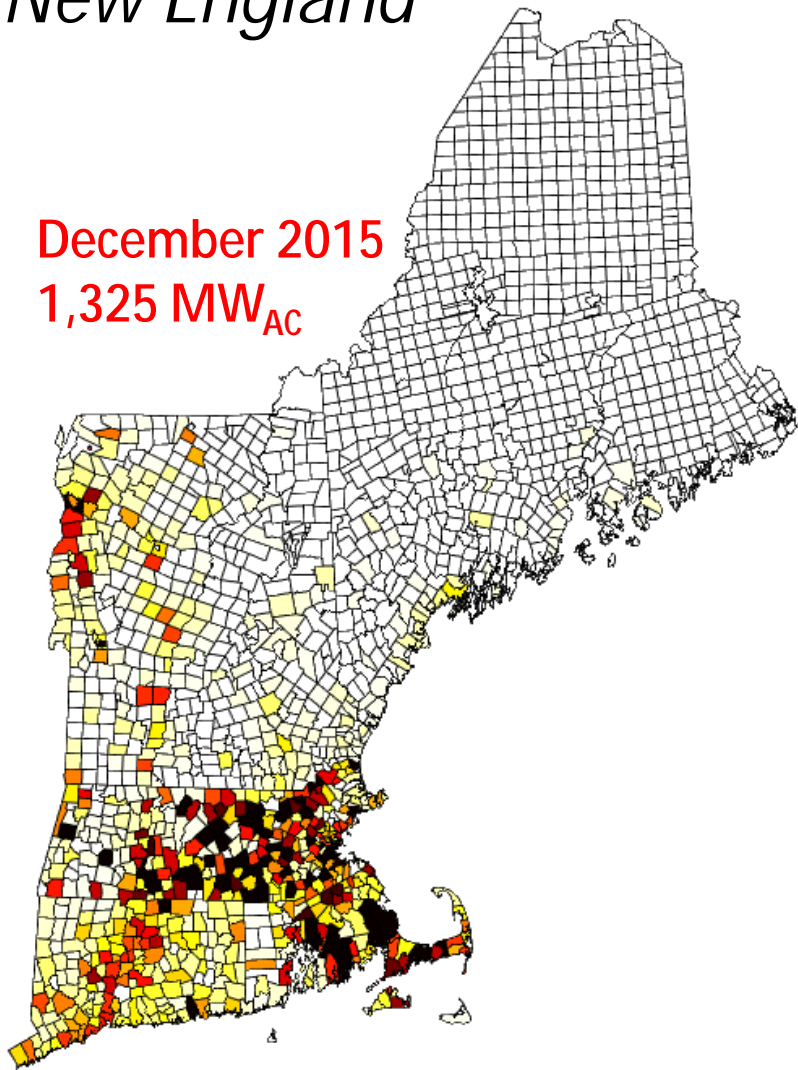
- The draft 2017 Photovoltaic (PV) forecast reflects recent development trends in the region, as indicated by data provided by region's Distribution Owners, and updated policy information provided by the New England states
 - Approximately 593 MW of PV (AC nameplate) development occurred in 2016
- Approximately 2,444 MW of PV (AC nameplate) development is projected from 2017 through 2026 for a total of 4,362 MW in 2026
- The focus of the PV forecast is distributed generation
 - I.e., it does not include large-scale PV projects that are > 5 MW in nameplate, e.g., those planned as part of the three-state Clean Energy RFP
- Details of the draft 2017 PV forecast are available at:

https://www.iso-ne.com/static-assets/documents/2017/02/2017_draft_pvforecast_20170228.pdf

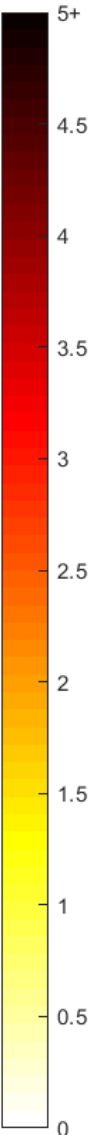
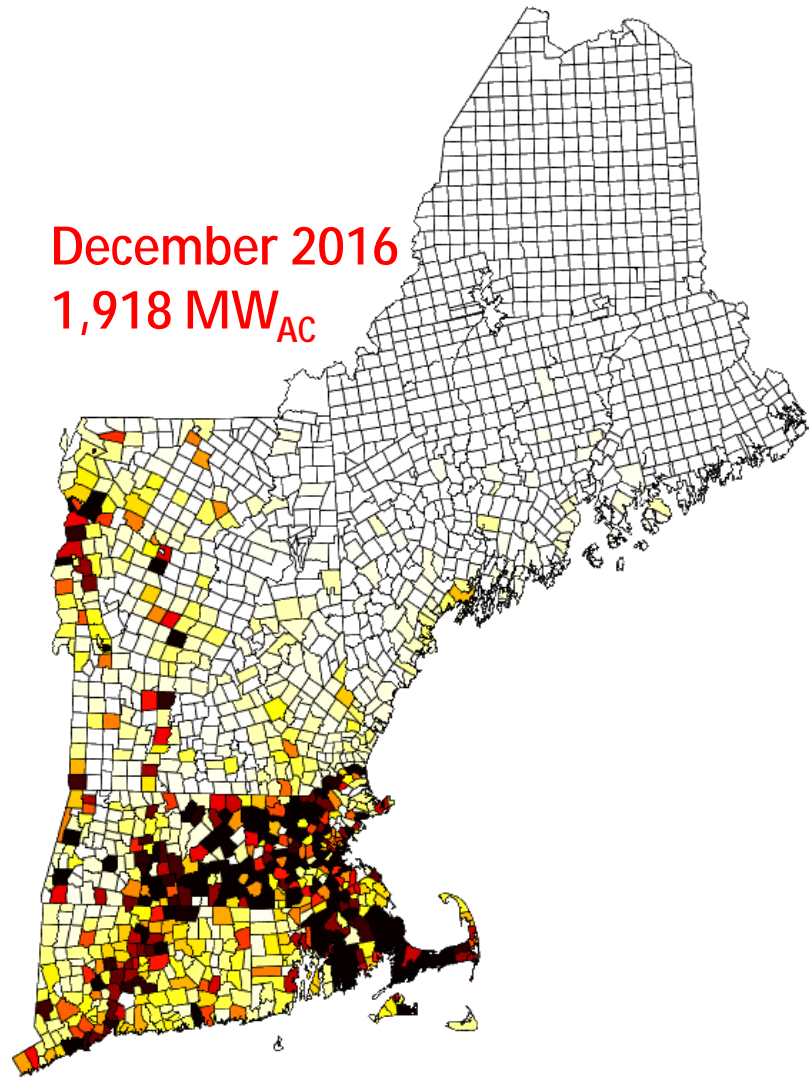
Year-Over-Year Installed PV Capacity

New England

December 2015
1,325 MW_{AC}



December 2016
1,918 MW_{AC}



More information can be found at: [Solar Power in New England: Locations and Impacts](#)

Final 2016 PV Forecast

Nameplate Capacity, MW_{ac}

States	Annual Total MW (AC nameplate rating)											Totals
	Thru 2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	
CT	188.0	85.5	104.5	81.0	81.0	81.0	55.8	54.3	45.0	45.0	45.0	866.1
MA	947.1	294.4	122.7	69.7	38.7	38.7	38.7	38.7	38.7	38.7	38.7	1,705.0
ME	15.3	4.7	4.7	4.4	4.4	4.4	4.2	3.9	3.9	3.9	3.9	57.9
NH	26.4	13.3	7.6	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	79.3
RI	23.6	21.6	38.7	36.0	36.0	25.9	9.1	6.6	6.6	6.6	6.6	217.2
VT	124.6	30.2	23.8	22.5	22.5	22.5	21.3	20.0	20.0	20.0	20.0	347.3
Regional - Annual (MW)	1325.0	449.6	301.9	217.7	186.7	176.5	133.2	127.5	118.2	118.2	118.2	3,272.8
Regional - Cumulative (MW)	1325.0	1774.7	2076.5	2294.2	2480.9	2657.4	2790.6	2918.1	3036.3	3154.6	3272.8	3,272.8

Notes:

- (1) Forecast values include FCM Resources, non-FCM Energy Only Generators, and behind-the-meter PV resources
- (2) The forecast reflects discount factors described on slides 24-25
- (3) All values represent end-of-year installed capacities

Draft 2017 PV Forecast

Nameplate Capacity, MW_{ac}

States	Annual Total MW (AC nameplate rating)											Totals
	Thru 2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	
CT	281.5	109.7	109.7	103.9	48.9	35.5	35.5	35.5	35.5	35.5	35.5	866.6
MA	1324.8	260.2	220.1	133.3	133.3	133.3	133.3	133.3	66.7	66.7	66.7	2,671.7
ME	22.1	6.5	6.5	6.2	6.2	5.8	5.5	5.5	5.5	5.5	5.5	80.6
NH	54.3	17.2	11.4	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	131.1
RI	36.8	39.3	39.3	31.8	31.8	15.2	10.2	10.2	10.2	10.2	10.2	244.9
VT	198.4	12.2	12.2	11.5	11.5	21.3	20.0	20.0	20.0	20.0	20.0	367.0
Regional - Annual (MW)	1918.0	445.0	399.1	292.7	237.7	217.1	210.5	210.5	143.8	143.8	143.8	4,361.9
Regional - Cumulative (MW)	1918.0	2363.0	2762.1	3054.8	3292.5	3509.7	3720.1	3930.6	4074.4	4218.1	4361.9	4,361.9

Notes:

- (1) Forecast values include FCM Resources, non-FCM Energy Only Generators, and behind-the-meter PV resources
- (2) The forecast reflects discount factors described on slides 24-25
- (3) All values represent end-of-year installed capacities

Treatment of PV in Load Forecast

- The majority of state-sponsored distributed PV does not participate in wholesale markets, but reduces the system load observed by ISO
- To properly account for PV in long-term planning, the finalized PV forecast is categorized as follows:
 1. PV as a capacity resource in the Forward Capacity Market (FCM)
 2. Non-FCM Energy Only Resources (EOR) and Generators
 3. Behind-the-meter PV (BTM PV)
- Similar to last year, estimated peak load reductions associated with BTM PV are used as load reductions in the ISO's long-term net load forecast

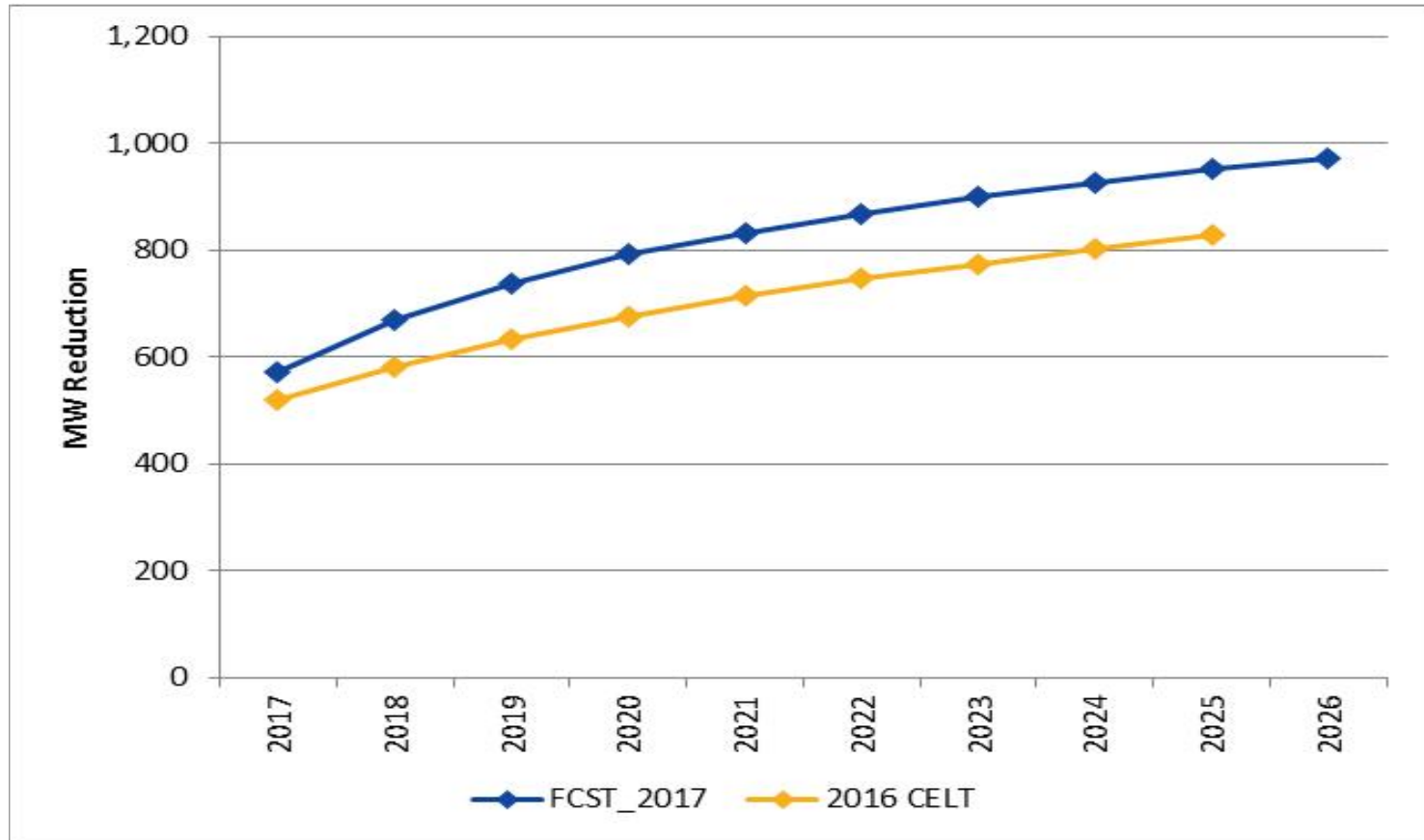
Similar to energy efficiency (EE), behind-the-meter PV is reconstituted into historical loads*

The 2017 gross load forecast reflects loads without PV load reductions

** Existing PV decreases the historical loads seen by the ISO, which are an input to the load forecast*

BTM PV Summer Peak Reduction

2017 Draft vs. Final 2016



DRAFT 2017 ENERGY AND SUMMER PEAK LOAD FORECAST

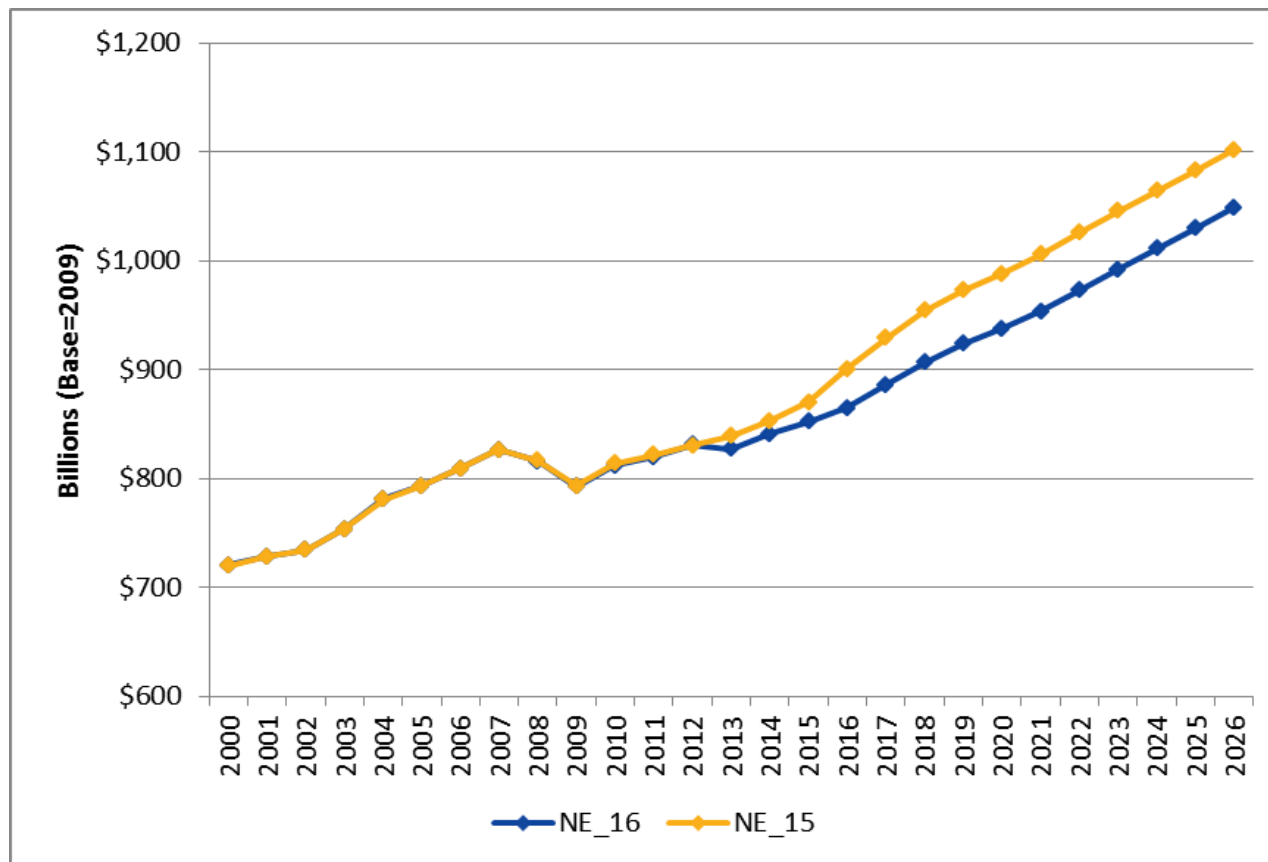
Draft 2017 Energy and Summer Peak Forecast

Summary

- Moody's economic forecast updated from November 2015 to October 2016
- Re-estimated econometric models, with the addition of 2016 data and removal of 2001 data, based on actual energy and daily peaks reconstituted with OP4, PDR, and BTM PV
 - These models are used to develop "gross" load forecasts
- The 2017 CELT forecast of energy, summer peak, PDR, and BTM PV are all draft
 - EE and PV forecasts are still being finalized
- The 2017 CELT energy and summer peak forecasts are lower than the 2016 CELT forecasts
- The draft forecast was presented to the NEPOOL Load Forecast Committee (LFC) on January 24, 2017 with no objections

Moody's 2016 and 2015 Economic Forecast

New England Gross State Product

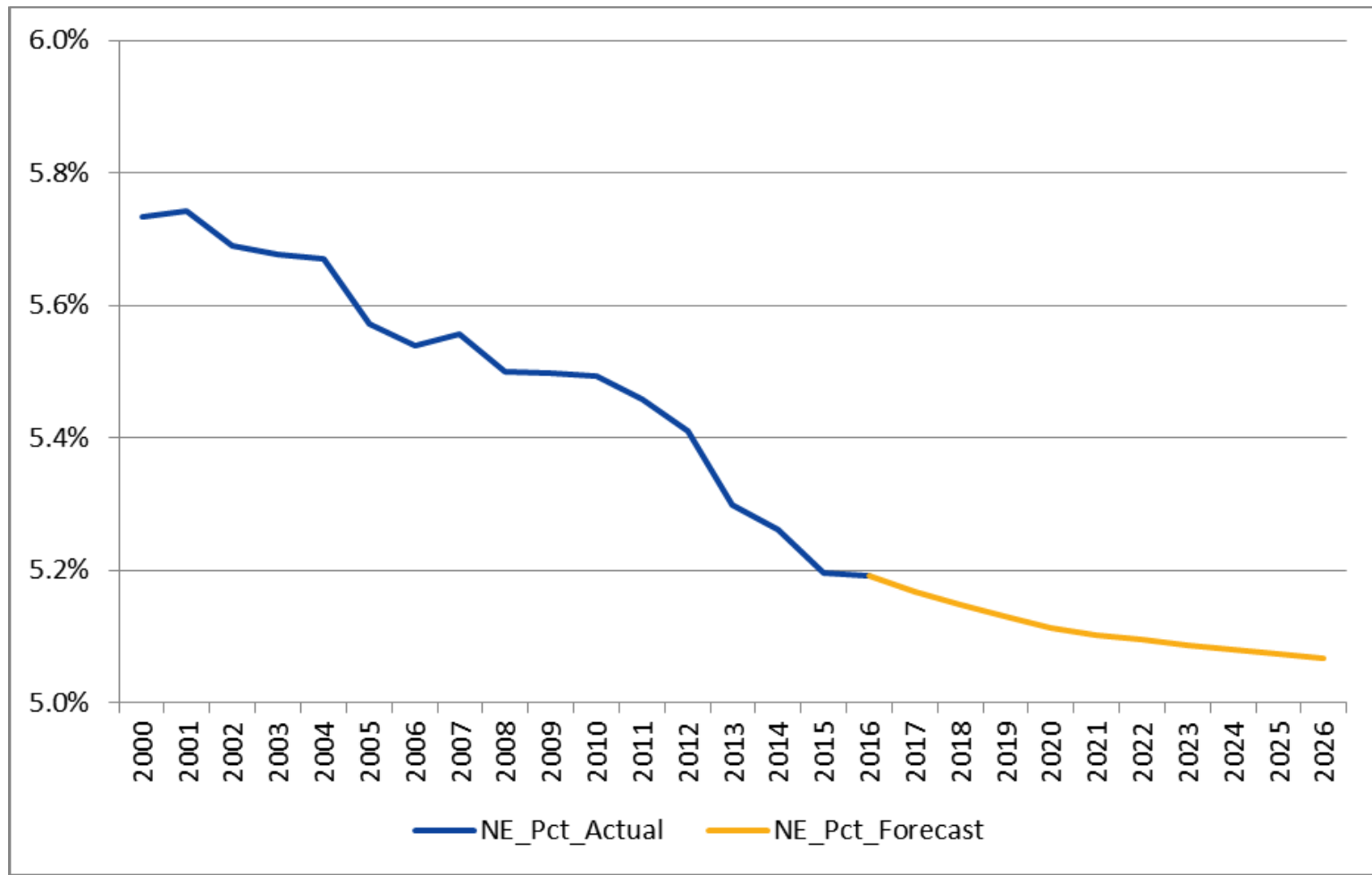


Notes:

- Compound Annual Growth Rate (CAGR) from 2015 thru 2026 lowered to 1.9% from last year's forecast of 2.2%.
- National CAGR, 2.1%, had little change from last year's forecast of 2.2%.

Moody's Economic Forecast

New England Percent of U.S. Gross Domestic Product



Gross Energy Forecast

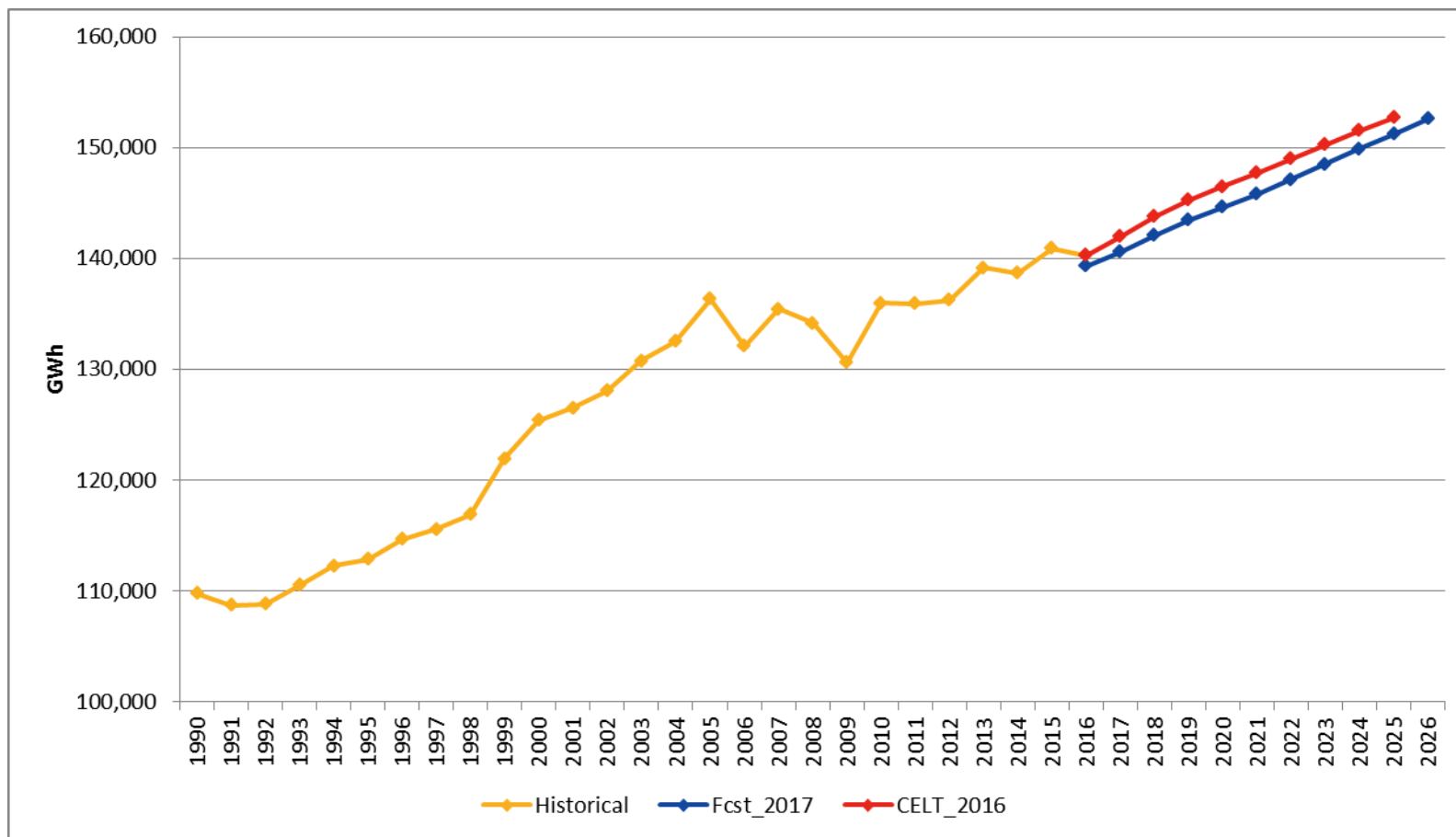
New England

ISO-NE subtracts impacts of Federal Efficiency Standards (EISA07) from the gross energy forecast

Year	Gross Energy Forecast (GWh)	Incremental Standards (GWh)	Gross Forecast with Standards (GWh)
2017	140,688	105	140,583
2018	142,217	139	142,078
2019	143,620	173	143,447
2020	144,815	204	144,611
2021	146,045	246	145,799
2022	147,428	301	147,127
2023	148,864	357	148,507
2024	150,285	401	149,884
2025	151,684	451	151,233
2026	153,092	499	152,593

ISO-NE Gross Energy – History and Forecast

Metered Energy + PDR + BTM PV – Federal Efficiency Standards

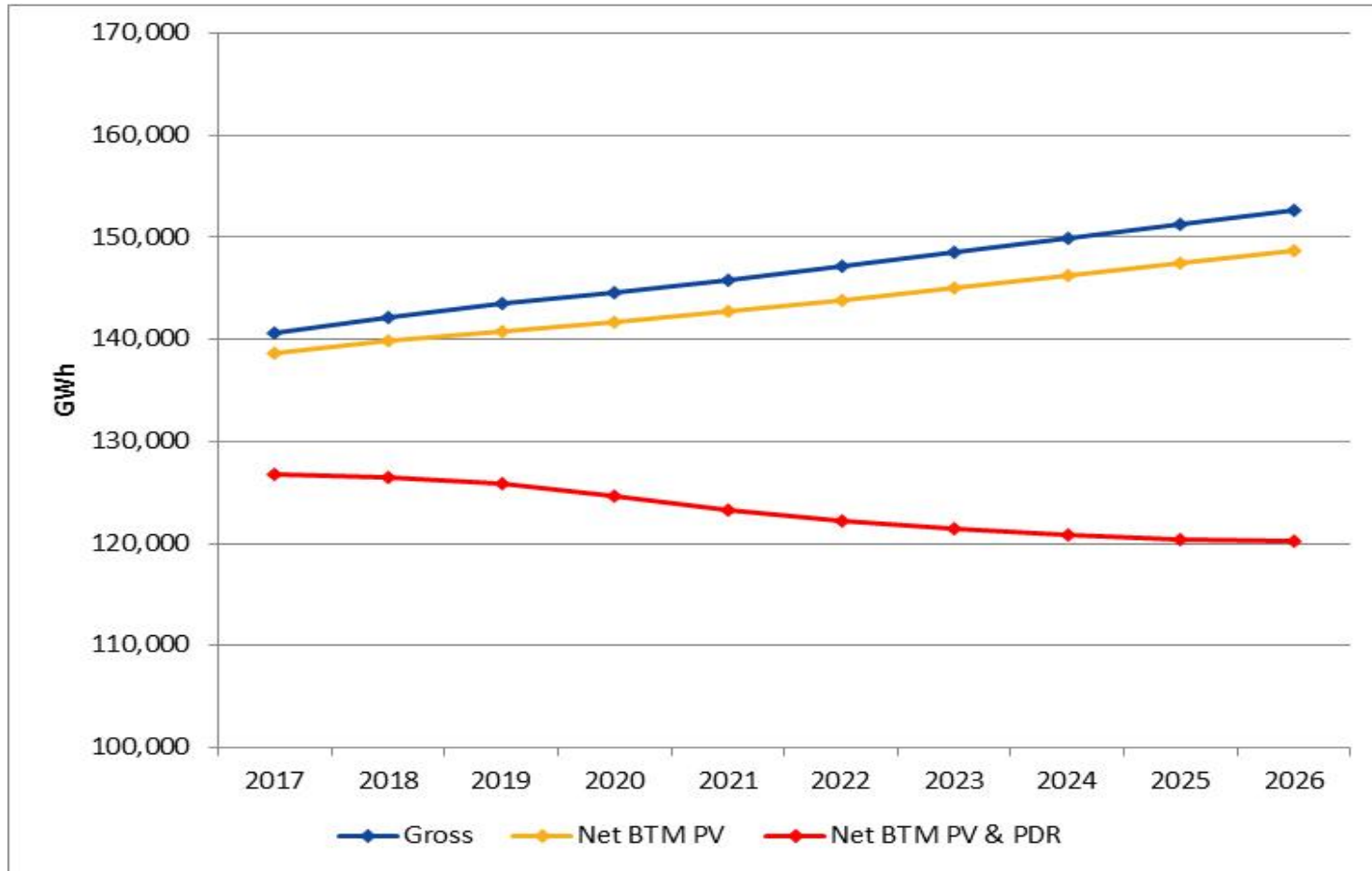


2017 (-1.0% , -1,419 GWh)

2021 (-1.3% , -1,914 GWh)

2025 (-1.0% , -1,506 GWh)

Draft 2017 CELT ISO-NE Energy Forecast



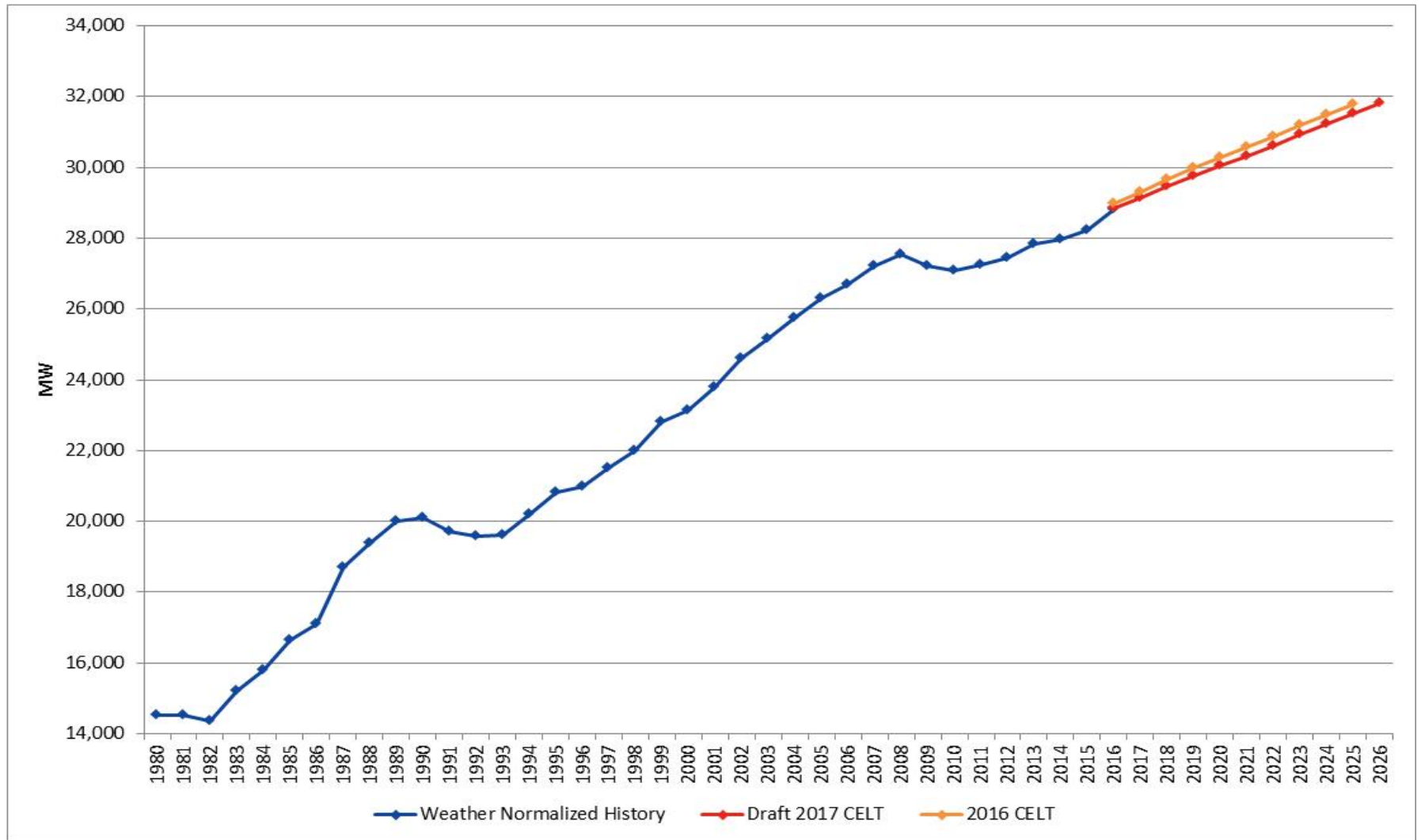
ISO-NE Forecast Comparison Table: Annual Energy

Draft 2017 CELT and 2016 CELT

	Draft 2017 CELT (GWh)				2016 CELT (GWh)				Change (GWh)			
Year	Gross	BTM PV	PDR	Net	Gross	BTM PV	PDR	Net	Gross	BTM PV	PDR	Net
2017	140,583	1,880	11,903	126,800	141,997	1,655	11,903	128,439	-1,414	225	0	-1,639
2018	142,078	2,282	13,279	126,517	143,775	1,898	13,279	128,598	-1,697	384	0	-2,081
2019	143,447	2,607	14,911	125,929	145,268	2,097	14,911	128,260	-1,821	510	0	-2,331
2020	144,611	2,865	17,038	124,708	146,486	2,278	16,800	127,408	-1,875	587	238	-2,700
2021	145,799	3,072	19,422	123,305	147,706	2,444	18,567	126,695	-1,907	628	855	-3,390
2022	147,127	3,269	21,623	122,235	148,982	2,582	20,220	126,180	-1,855	687	1,403	-3,945
2023	148,507	3,463	23,631	121,413	150,267	2,713	21,765	125,789	-1,760	750	1,866	-4,376
2024	149,884	3,639	25,442	120,803	151,513	2,836	23,209	125,468	-1,629	803	2,233	-4,665
2025	151,233	3,782	27,059	120,392	152,731	2,959	24,559	125,213	-1,498	823	2,500	-4,821
2026	152,593	3,926	28,486	120,181								

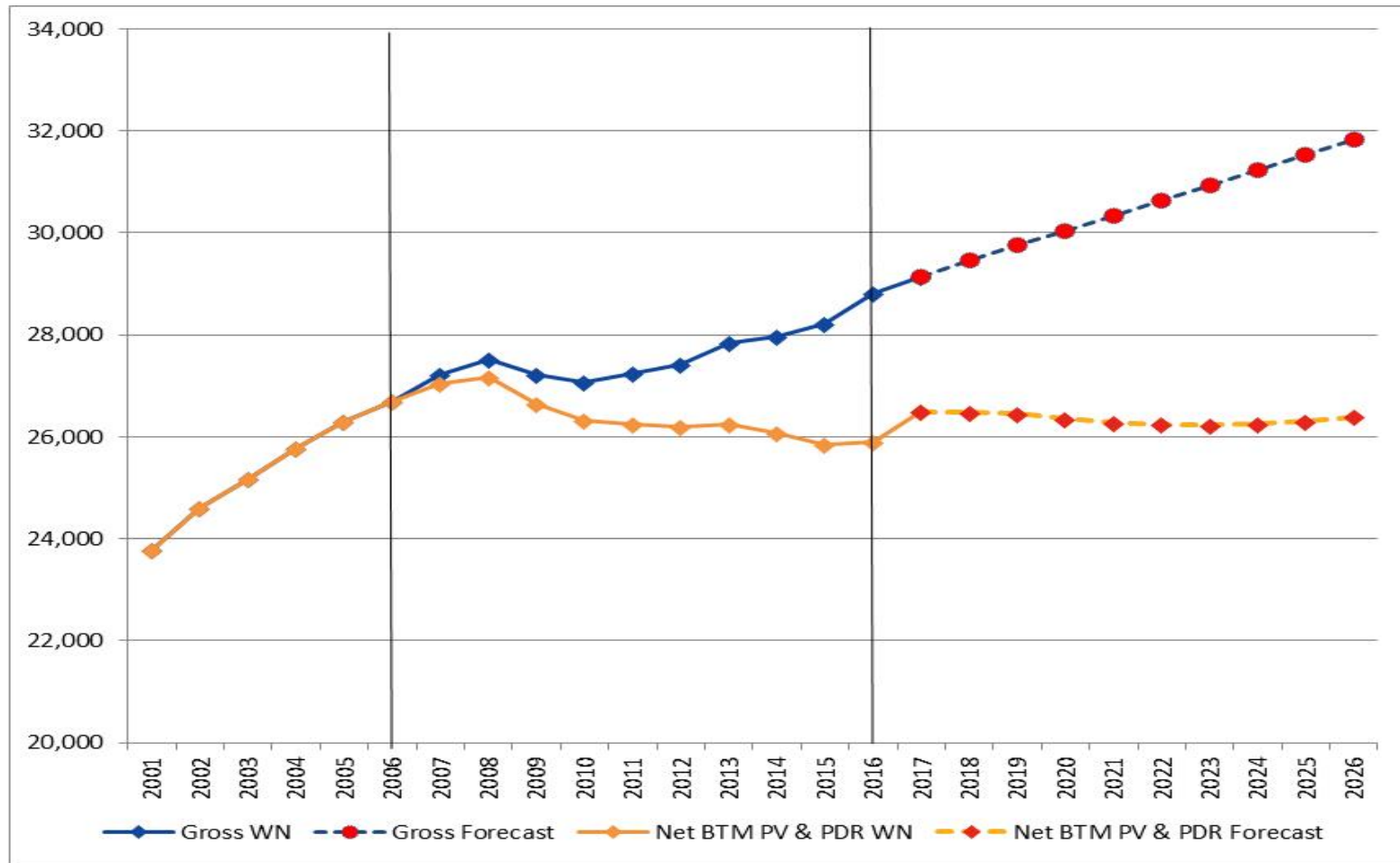
ISO-NE Gross 50/50 Summer Peak Forecast

Reconstituted with OP4, PDR and BTM PV



Draft 2017 CELT ISO-NE 50/50 Summer Peak Forecast

Weather Normal History 2001-2016 and Draft Forecast

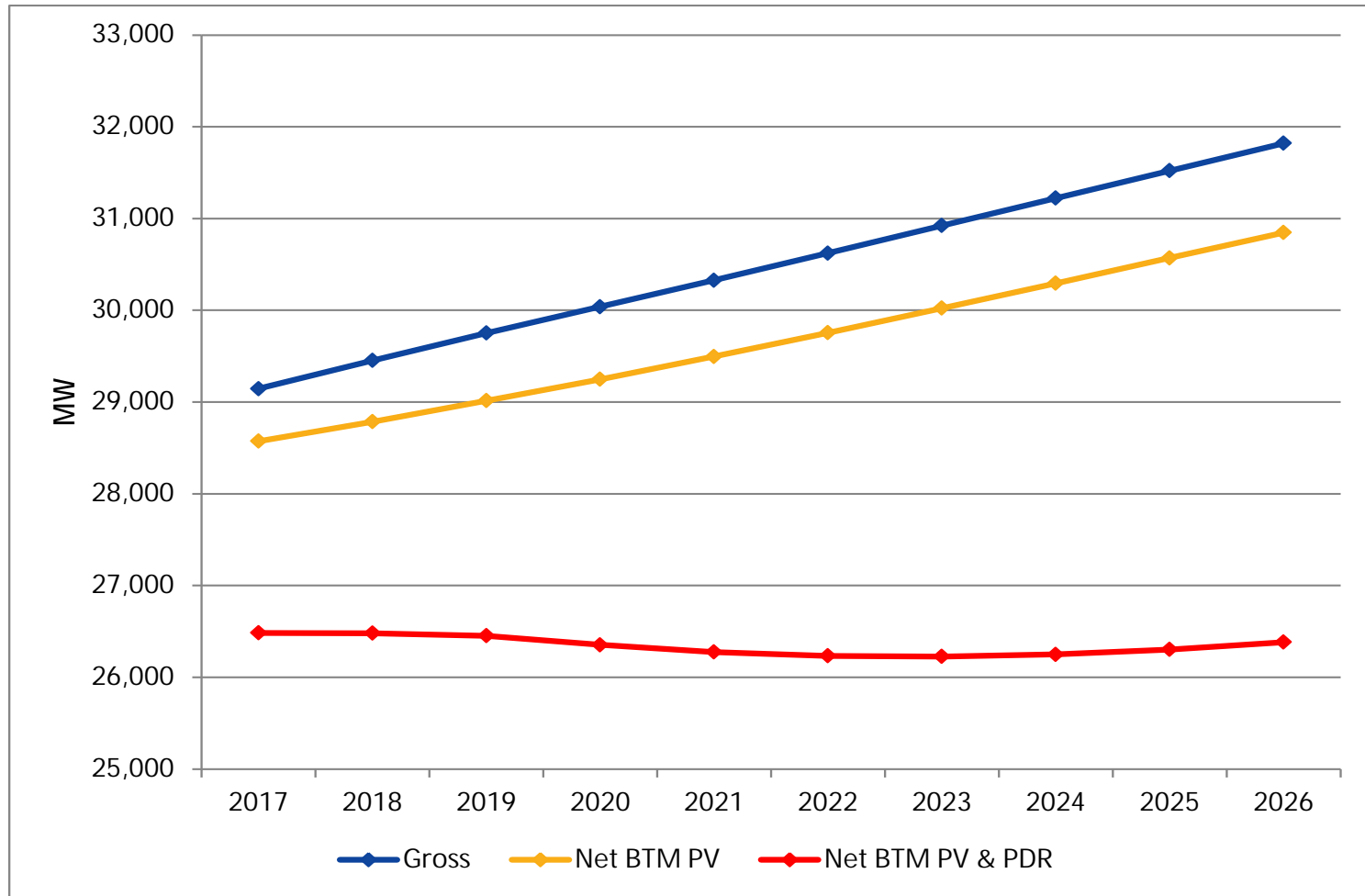


Draft 2017 ISO-NE Forecast

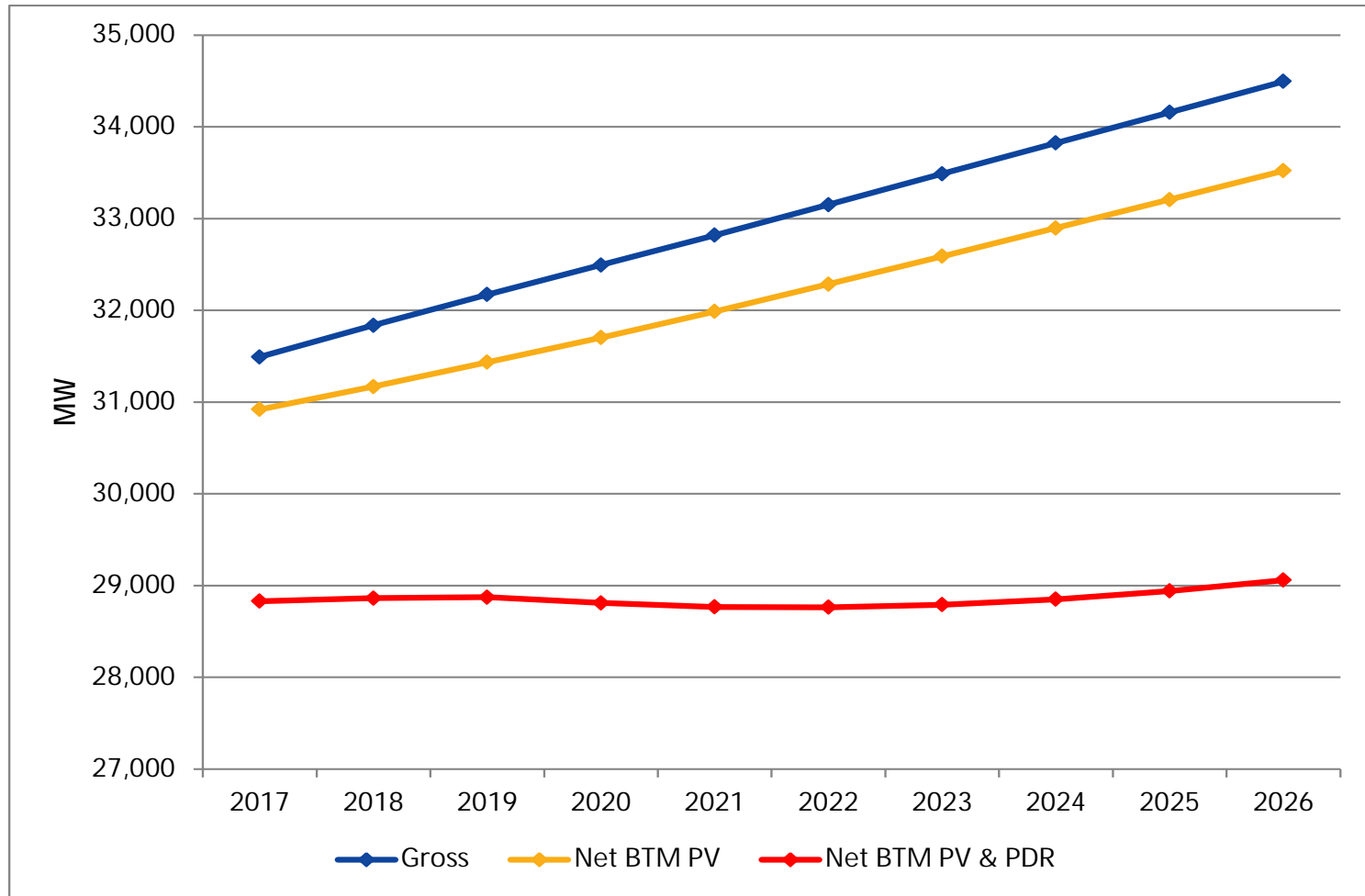
Energy, Summer Peak, PDR, and BTM PV

Summer Peak (MW)							Annual Energy (GWh)			
Year	Gross	Gross	BTM PV	PDR	Net	Net	Gross	PV:BTM	PDR	Net
	50/50	90/10			50/50	90/10				
2017	29,146	31,529	572	2,089	26,485	28,868	140,583	1,880	11,903	126,800
2018	29,454	31,873	668	2,306	26,480	28,899	142,078	2,282	13,279	126,517
2019	29,753	32,209	739	2,561	26,453	28,909	143,447	2,607	14,911	125,929
2020	30,039	32,531	792	2,893	26,354	28,846	144,611	2,865	17,038	124,708
2021	30,327	32,855	831	3,220	26,276	28,804	145,799	3,072	19,422	123,305
2022	30,623	33,188	867	3,522	26,234	28,799	147,127	3,269	21,623	122,235
2023	30,923	33,525	900	3,797	26,226	28,828	148,507	3,463	23,631	121,413
2024	31,223	33,861	928	4,046	26,249	28,887	149,884	3,639	25,442	120,803
2025	31,521	34,196	951	4,267	26,303	28,978	151,233	3,782	27,059	120,392
2026	31,820	34,531	973	4,463	26,384	29,095	152,593	3,926	28,486	120,181
CAGR	1.0%	1.0%			0.0%	0.1%	0.9%			-0.6%

Draft 2017 ISO-NE 50/50 Summer Peak Forecast



Draft 2017 ISO-NE 90/10 Summer Peak Forecast



Forecast Comparison Table: ISO-NE Gross Summer Peak

Draft 2017 vs. 2016 CELT

	Gross 50/50 Summer Peak				Gross 90/10 Summer Peak			
	Fcst_2017	2016 CELT	Change	% Change	Fcst_2017	2016 CELT	Change	% Change
2017	29,146	29,307	-161	-0.5%	31,529	31,680	-151	-0.5%
2018	29,454	29,652	-198	-0.7%	31,873	32,061	-188	-0.6%
2019	29,753	29,975	-222	-0.7%	32,209	32,420	-211	-0.7%
2020	30,039	30,276	-237	-0.8%	32,531	32,757	-226	-0.7%
2021	30,327	30,578	-251	-0.8%	32,855	33,093	-238	-0.7%
2022	30,623	30,883	-260	-0.8%	33,188	33,435	-247	-0.7%
2023	30,923	31,190	-267	-0.9%	33,525	33,777	-252	-0.7%
2024	31,223	31,493	-270	-0.9%	33,861	34,116	-255	-0.7%
2025	31,521	31,794	-273	-0.9%	34,196	34,452	-256	-0.7%
2026	31,820				34,531			
CAGR	1.0%	1.0%			1.0%	1.1%		

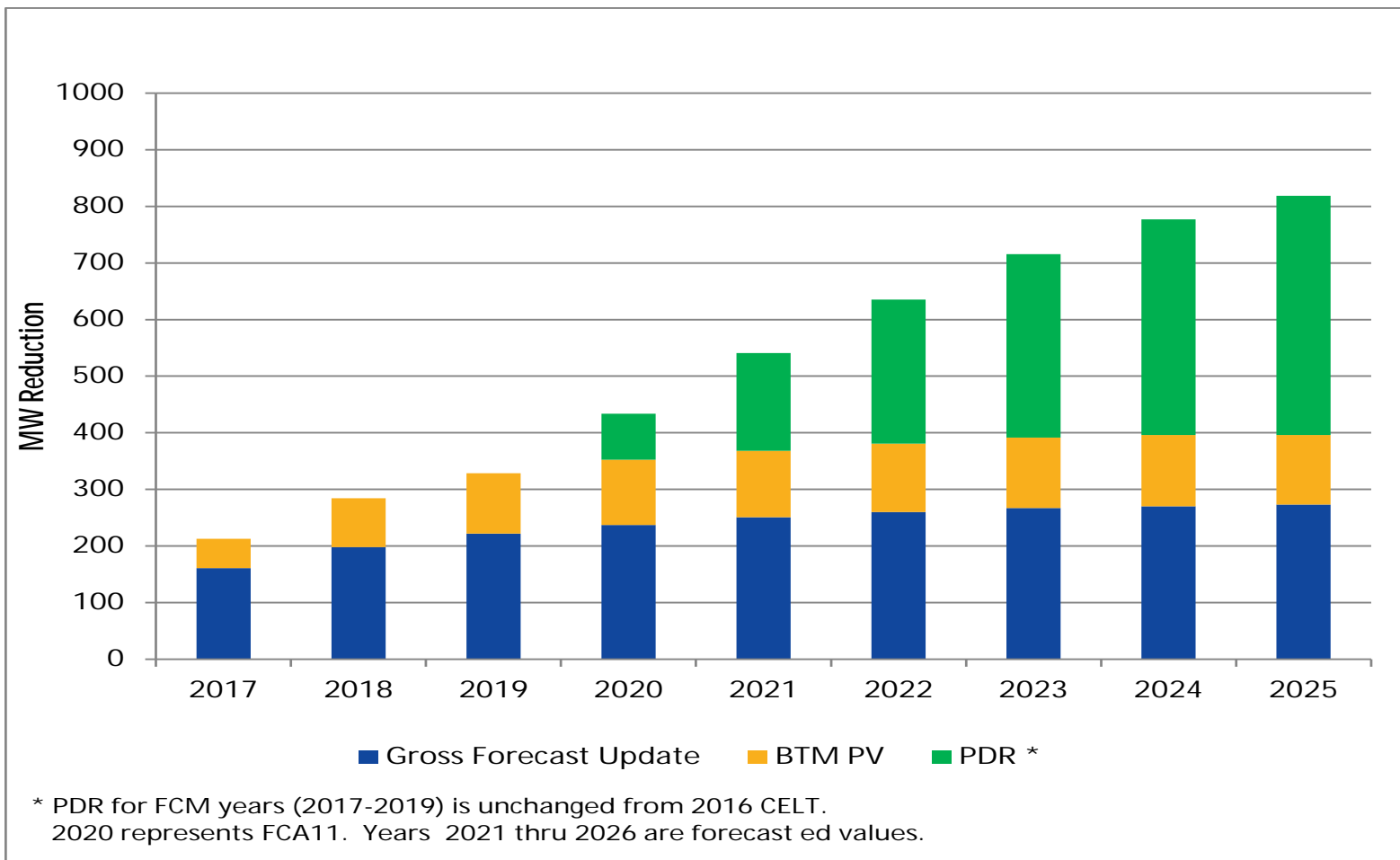
Forecast Comparison Table: ISO-NE Net Summer Peak

Draft 2017 vs. 2016 CELT

	Net 50/50 Summer Peak				Net 90/10 Summer Peak			
	Fcst_2017	2016 CELT	Change	% Change	Fcst_2017	2016 CELT	Change	% Change
2017	26,485	26,698	-213	-0.8%	28,868	29,071	-203	-0.7%
2018	26,480	26,765	-285	-1.1%	28,899	29,174	-275	-0.9%
2019	26,453	26,783	-330	-1.2%	28,909	29,227	-318	-1.1%
2020	26,354	26,789	-435	-1.6%	28,846	29,269	-423	-1.4%
2021	26,276	26,816	-540	-2.0%	28,804	29,332	-528	-1.8%
2022	26,234	26,870	-636	-2.4%	28,799	29,422	-623	-2.1%
2023	26,226	26,942	-716	-2.7%	28,828	29,529	-701	-2.4%
2024	26,249	27,026	-777	-2.9%	28,887	29,649	-762	-2.6%
2025	26,303	27,122	-819	-3.0%	28,978	29,781	-803	-2.7%
2026	26,384				29,095			
CAGR	0.0%	0.2%			0.1%	0.3%		

Change in Summer Peak Net Load Reduction by Component

Draft 2017 vs. 2016 CELT



Next Steps

- The finalized 2017 CELT forecasts will be published by May 1, 2017 and will include:
 - Final EE forecast
 - Final PV forecast
 - Including BTM PV
 - Final ISO-NE and state forecasts for:
 - Annual energy
 - Seasonal peaks
 - Gross and net of PDR/BTM PV

Questions

